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(54) [Title of the Invention]

Organic Thin Film Light Emitting Element

(57) [Abstract]

[Object]

To provide an organic thin film light emitting element, in which light can be emitted at low voltage and luminous efficiency is high, by using a metal oxide thin film with a higher work function than that of indium tin oxide (ITO) for an anode to lower the energy barrier to a hole transporting layer or a light emitting layer.

[Solving Means]

In an organic thin film light emitting element, in which an anode 12 is formed on a substrate 10 and organic compound layers such as a hole transporting layer 18 and a light emitting layer 16, and a cathode 14 are formed thereover, the anode 12 is formed of a metal oxide thin film with a higher work function than that of ITO or a two-layer structure thin film with ITO.

[Scope of Claims]

[Claim 1]

An organic thin film light emitting element comprising:

an anode;

a cathode; and

one or a plurality of organic compound layers which are sandwiched therebetween,

characterized in that the anode is formed of a metal oxide thin film with a higher work function than that of indium tin oxide (ITO).

[Claim 2]

The organic thin film light emitting element as described in claim 1, characterized in that the anode has a two-layer structure of an ITO thin film having a film thickness ranging from 500 angstrom to 2000 angstrom and a metal oxide thin film

ranging from 50 angstrom to 300 angstrom.

[Claim 3]

The organic thin film light emitting element as described in claim 1, characterized in that the organic compound layer is a light emitting layer.

[Claim 4]

The organic thin film light emitting element as described in claim 1, characterized in that the organic compound layer comprises a hole transporting layer and a light emitting layer.

[Claim 5]

The organic thin film light emitting element as described in claim 1, characterized in that the organic compound layer comprises a light emitting layer and an electron transporting layer.

[Claim 6]

The organic thin film light emitting element as described in claim 1, characterized in that the organic compound layer comprises a hole transporting layer, a light emitting layer and an electron transporting layer.

[Claim 7]

The organic thin film light emitting element as described in claim 1, characterized in that the metal oxide is an oxide such as vanadium oxide, ruthenium oxide or molybdenum oxide in which a work function is higher than 4.6 eV.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention belongs to]

The present invention relates to a light emitting element which is used for a flat panel light emitting display, and particularly relates to an improvement of an organic thin film light emitting element using a fluorescent organic compound as a light emitting material.

[0002]

[Prior Art]

Recently, with progress to an information society, needs for low power

consumption and thin displays instead of the conventional CRT are growing. A liquid crystal display and a plasma display are noted as such a display, and they are already in practical use. However, needs of the age are still growing, and rather less power consumption and clearer full color displays are expected to be achieved.

[0003]

Nowadays, expectations for an organic thin film light emitting element using an organic compound are raised with these needs in the background. As an element structure which is reported so far, there is a structure in which one or a plurality of organic compound layers are sandwiched between an anode and a cathode, and regarding the organic compound layer, there is a two-layer structure or a three-layer structure.

[0004]

As an example of the two-layer structure, there is a structure in which a hole transporting layer and a light emitting layer are formed between an anode and a cathode (Laid-Open No. S59-194393, Appl. Phys. Lett. 51,913(1987)), or a structure in which a light emitting layer and an electron transporting layer are formed between an anode and a cathode (USP No. 5,085947, Laid-Open No. H2-250952, Appl. Phys. Lett. 55. P1489 (1989)). Additionally, as an example of the three-layer structure, a structure in which a hole transporting layer, a light emitting layer and an electron transporting layer are formed between an anode and a cathode (Appl. Phys. Lett. 57,531(1990)) is noted. Further, a single layer structure in which a single layer has all functions by using a high molecule and a mixed system (Nature, 345.539(1990), Appl. Phys. Lett. 61,761(1992)) is also reported. These element structures are shown in FIGS. 6, 7, 8 and 9.

[0005]

FIG. 6 shows an example of the single layer structure in which a light emitting layer 16 which is a single organic compound layer is formed between an anode 12 provided on a substrate 10 and a cathode 14. In this case, the light emitting layer 16 also serves as a hole transporting layer and an electron transporting layer.

[0006]

FIG. 7 shows an example of the two-layer structure in which a light emitting

layer 16 and a hole transporting layer 18 which are organic compound layers are formed between an anode 12 provided on a substrate 10 and a cathode 14. In this case, the light emitting layer 16 also serves as an electron transporting layer.

[0007]

FIG. 8 shows an example of the two-layer structure in which a light emitting layer 16 and an electron transporting layer 20 which are organic compound layers are formed between an anode 12 provided on a substrate 10 and a cathode 14. The light emitting layer 16 also serves as a hole transporting layer in this case.

[0008]

FIG. 9 shows an example of the three-layer structure in which a light emitting layer 16, a hole transporting layer 18 and an electron transporting layer 20 which are organic compound layers are formed between an anode 12 provided on a substrate 10 and a cathode 14.

[0009]

A light emission mechanism in these organic thin film light emitting elements is as follows: A hole injected from the anode and an electron injected from the cathode reach the light emitting layer 16 through the hole transporting layer 18 or the electron transporting layer 20, and they are recombined there to achieve an excited state of an organic compound which composes the light emitting layer 16. When the excited state returns to a ground state, light of the same wavelength as the fluorescence of the organic compound is emitted.

[0010]

An organic compound used as a material for the light emitting layer is a material which exhibits strong fluorescence. So far, various organic compounds are reported as materials that can be used for the hole transporting layer 18, the light emitting layer 16 and the electron transporting layer 20. For example, aromatic tertiary amine is reported as a material for the hole transporting layer 18.

[0011]

In addition, as a material for the light emitting layer 16, aluminum trisoxine which is expressed in the chemical formula below (Laid-Open No. S59-194393, Laid

Open No. S63-295695)

[Chemical formula 1],

a styryl amine derivative and a styryl benzene derivative (Laid-Open No. H2-209988) are reported.

[0012]

Additionally, as a material for the electron transporting layer 20, an oxadiazole derivative and the like (Appl. Phys. Lett. 63,2032 (1993)) are reported.

[0013]

There are many reported examples not only as for these low-molecular weight compounds but also as for a high-molecular weight compound. In particular, as for a poly (P-phenylenevinylene) based derivative (Nature, 347,539(1990)), favorable properties are obtained even in the single layer structure element.

[0014]

The capability of an organic thin film light emitting element using these materials is sufficiently on the practical level as a light emitting element from the aspect of a luminescent color and brightness thereof.

[0015]

[Problem to be solved by the Invention]

However, these organic thin film light emitting elements have been not yet in practical use. The major reason is that the durability of the element is low.

[0016]

So far, high luminance of several thousands cd/m^2 is achieved in the initial stages by a direct current voltage of approximately 10 V by applying various element structures and organic compounds. However, property deterioration such as a luminance decrease or a drive voltage increase occurs due to continuous driving or a long storage, which prevents a practical use of the organic thin film light emitting element. Several factors that control this element lifetime are reported, although it was considered heretofore that the heat resistance of the thin film was a major factor. Therefore, in order to stabilize a film structure of the organic compound layer, it is attempted to synthesize an organic compound that is superior in heat stability, namely,

in which the softening temperature (Tg) or the melting point is high (Appl. Phys. Lett 61, 2503 (1992)).

[0017]

However, according to systematic experiments in which a triphenyldiamine derivative of the aromatic tertiary amine expressed by the chemical formula bellow

[Chemical Formula 2]

is focused, it is reported recently that the element lifetime is more related to an ionization potential of a hole transporting layer than to the softening temperature or the melting point (Appl. Phys. Lett., 66.2679 (1995)). This means that the element lifetime is longer as the energy barrier between indium tin oxide (ITO) that is an anode and a hole transporting layer, namely, an energy difference between Fermi level of the ITO electrode and a highest occupied level of the hole transporting layer, is smaller.

[0018]

Generally, it is known that Fermi level of the ITO electrode is 4.6 eV (Nature, Vol.370, 354 (1994)), and this value corresponds to the work function. In addition, it is known that the highest occupied level of triphenyldiamine (TPD) that is a typical diamine derivative used for the hole transporting layer is 5.5 eV (Appl. Phys. Lett., 61, 2503 (1992)), and this value corresponds to the ionization potential.

[0019]

In the case where the TPD is used for the hole transporting layer, there is a barrier of approximately 0.9 eV between the ITO electrode and the hole transporting layer for a hole carrier. When this energy difference is small, exothermic heat of the element can be suppressed without having to apply too much voltage to the barrier portion. It is attempted to synthesize a material with a larger ionization potential using many diamine derivatives, however, there is a limit in lowering the barrier only by an approach using an organic material. Therefore, it is expected to develop a transparent electrode with the higher work function than that of the conventional ITO by improving an electrode material.

[0020]

Note that the energy barrier between an anode and a light emitting layer is a

problem in an element in which a light emitting layer also serves as a hole transporting layer. For example, there is a barrier of 0.4 eV in the case of poly (P-phenylenevinylene) with an ionization potential of 5.0 eV (Nature, 370, 354 (1990)).

[0021]

The present invention is made in view of the conventional problems described above, and the object is to provide an organic thin film light emitting element in which drive voltage can be lowered, light emission capability can be kept for a long time and the durability is high by lowering the energy barrier to a hole transporting layer or a light emitting layer using a metal oxide thin film with the higher work function than that of ITO which is the conventional anode material.

[0022]

[Means to solve the Problem]

In the invention as described in claim 1, an organic thin film light emitting element comprising an anode, a cathode and one or a plurality of organic compound layers which are sandwiched therebetween is characterized in that the anode is formed of a metal oxide thin film with the higher work function than that of indium tin oxide (ITO) in order to achieve the object described above.

[0023]

In the invention as described in claim 2, the organic thin film light emitting element as described in claim 1 is characterized in that the anode has a two-layer structure of an ITO thin film having a film thickness ranging from 500 angstrom to 2000 angstrom and a metal oxide thin film ranging from 50 angstrom to 300 angstrom.

[0024]

In the invention as described in claim 3, the organic thin film light emitting element as described in claim 1 is characterized in that the organic compound layer is a light emitting layer.

[0025]

In the invention as described in claim 4, the organic thin film light emitting element as described in claim 1 is characterized in that the organic compound layer comprises a hole transporting layer and a light emitting layer.

[0026]

In the invention as described in claim 5, the organic thin film light emitting element as described in claim 1 is characterized in that the organic compound layer comprises a light emitting layer and an electron transporting layer.

[0027]

In the invention as described in claim 6, the organic thin film light emitting element as described in claim 1 is characterized in that the organic compound layer comprises a hole transporting layer, a light emitting layer and an electron transporting layer.

[0028]

In the invention as described in claim 7, the organic thin film light emitting element as described in claim 1 is characterized in that the metal oxide is an oxide such as vanadium oxide, ruthenium oxide or molybdenum oxide in which the work function is higher than 4.6 eV.

[0029]

[Embodiments of the Invention]

Hereinafter, preferable embodiments of the present invention are described based on the drawings.

[0030]

FIG. 1 shows a cross-sectional view of an organic thin film light emitting element according to the present invention. In FIG. 1, an anode 12 is formed on a substrate 10 formed of glass or the like, a hole transporting layer 18 of TPD is formed on the anode 12, a light emitting layer 16 of an aluminum-quinolinol complex (Alq) is formed on the hole transporting layer 18 and a cathode 14 of an MgAg alloy is formed on the light emitting layer 16.

[0031]

As the anode 12, a material in which the work function is higher than that of ITO that is the conventional anode material and the conductivity is high is used. For instance, ruthenium oxide (RuO_X), molybdenum oxide (MoO_X) or vanadium oxide (VO_X) or the like is preferable.

[0032]

In Table 1, examples of the work function of each metal oxide thin film are shown. These values are measured by the atmospheric ultraviolet photoelectron spectroscopy. The work function of the metal oxide thin film shown in Table 1 is a higher value than that of ITO, and thus it can be used as the anode material for the organic thin film light emitting element according to the present invention.

[0033]

[Table 1]

Metal Oxide Thin Film	Work function (eV)
RuOx	4.9
MoOx	5.4
VOx	5.4
ITO	4.6

A metal oxide thin film with limited optical transparency among these metal oxide thin films is made to be a two-layer structure electrode with ITO. An example thereof is shown in FIG. 2. In FIG. 2, an ITO layer 22 is formed on a substrate 10, a metal oxide thin film 24 is formed on the ITO layer 22, and thus a two-layer structure anode 12 is composed. Note that a predetermined organic compound layer and a cathode are formed over the metal oxide thin film 24, however, the illustration thereof is omitted here.

[0034]

When the anode has the two-layer structure, the film thickness of the metal oxide thin film 24 is preferably less than or equal to 300 angstrom and equal to or more than 50 angstrom. The film thickness of the ITO is set to be in a range from 500 angstrom to 2000 angstrom. The metal oxide thin film may be manufactured by electron beam deposition, a direct current sputtering method, an RF-magnetron sputtering method, an ICB deposition method or the like, namely, a manufacturing method thereof is not limited as long as it is used to manufacture the oxide thin film.

[0035]

An organic compound which can be used in the present invention is not limited

to the one shown in FIG. 1, but all the known materials can be applied. For example, as a material for the hole transporting layer, aromatic tertiary amine (USP No. 4, 175, 960, USP No. 4, 539, 507, Phil. Mag. B, 53, 193 (1986)), a phthalocyanine derivative, and a pyrazoline derivative are noted, and particularly, the aromatic tertiary amine is the most effective compound. As a material for the light emitting layer, a metal chelated oxinoid compound (Laid-Open No.S59-194393), an oxadiazole derivative, a butadiene derivative, a perylene derivative, a styrylbenzene derivative (Laid-Open No.H2-247277), a perynone derivative and the like are noted. As a material for the electron transporting layer, an oxadiazole compound (Appl. Phys. Lett. 55, 1489 (1989)), a butadiene derivative, a perylene derivative and the like are noted, and, additionally, a metal chelated oxinoid compound (Laid-Open No.S59-194393) can be also used.

[0036]

As a cathode material, silver, tin, magnesium, aluminum, calcium in each of which the work function is low, or an alloy thereof are used. In addition, zinc oxide doped with aluminum or germanium can be also used as a transparent cathode. At least one of the anode and the cathode is preferably sufficiently transparent in a light emission wavelength region of the element.

[0037]

As shown in FIG. 1, the organic thin film light emitting element according to the present invention is composed as an element by laminating each layer described above in sequence on a glass substrate or a semiconductor substrate of silicon or the like. They may be sealed in a glass cell with silicon oil or the like for element stability, particularly for protection against moisture in the air.

[0038]

Note that the organic thin film light emitting element according to the present invention is not limited to the structure shown in FIG. 1, and it may also have a structure shown in FIG. 6, 7, 8 or 9 if necessary.

[0039]

Hereinafter, a specific example of the organic thin film light emitting element according to the present invention is described more in detail by embodiments.

[0040]

[Embodiments]

Embodiment 1. A manufacturing method of a metal oxide thin film and a property thereof are described in the present embodiment.

[0041]

A metal oxide thin film is formed by a radio-frequency magnetron sputtering method on a glass substrate by using each material shown in Table 1. A forming condition and a property of this metal oxide thin film are shown in Table 2.

[0042]

[Table 2]

Metal oxide thin film	Forming condition		Typical composition	Film Thickness (Å)	Resistivity (Ω cm)	Light Transmittance (%)
	Target	Sputtering Gas				
RuOx	Ru	Ar(70%) + O2(30%)	$RuO_{1.92}$	3680	2.7×10^{-4}	10
MoOx	MoO3	Ar	MoO_3	2150	1.2×10^{-2}	10
VOx	V205	Ar	$VO_{2.22}$	1320	10^5	20
ITO	ITO(5wt%SnO2)	Ar(99%) + O2(1%)		1720	3.3×10^{-4}	90

The substrate temperature is set to be 150 °C, and sputtering gas pressure is set to be 2×10^{-3} Torr (0.27 Pa). A molybdenum oxide thin film and a ruthenium oxide thin film indicate high conductivity, and a vanadium oxide thin film is semiconducting. These metal oxide thin films are colored and optical transparency thereof in a visible range is low as shown in Table 2, thus, it is preferable that they have the two-layer structure with ITO as described above. In Table 2, a typical composition of each metal oxide thin film is also indicated as a reference. This composition is slightly changed

depending on a condition of film formation by sputtering (gas pressure, gas type).

[0043]

Table 3 shows conductivity and light transmittance of a two-layer structure electrode as shown in FIG. 2 in which ITO and the metal oxide thin film are laminated. The film thickness of the metal oxide thin film is set to be less than or equal to 300 angstrom in order to increase transparency. In addition, the film thickness of ITO is set to be 1200 angstrom.

[0044]

In the present embodiment, the surface resistance can be set to be approximately 25 Ω/□ by the electrode having the two-layer structure. Further, the light transmittance can be higher than the value of each metal oxide thin film shown in FIG. 2.

[0045]

[Table 3]

Transparent Electrode	Surface Resistance (Ω/□)	Transmittance (%)
RuOx/ITO	22.5	60
MoOx/ITO	29.1	40
VOx/ITO	33	60
ITO	20	90

Embodiment 2. In the present embodiment, an organic thin film light emitting element having a structure shown in FIG. 1 is manufactured and its properties are evaluated.

[0046]

An anode of a vanadium oxide thin film of approximately 1500 angstrom is formed on a glass substrate by the method of the embodiment 1. TPD of approximately 500 angstrom is formed as a hole transporting layer on the anode by a vacuum deposition method under a condition where vacuum degree is approximately 2×10^{-7} Torr (2.7×10^{-5} Pa) and deposition rate is approximately 30 angstrom/minute. As a light emitting layer, an aluminum quinolinol complex is used. As a cathode, an alloy of Mg and Ag (Mg:Ag = 10:1) of approximately 1800 angstrom is formed under a

condition where vacuum degree is 1×10^{-6} Torr (1.3×10^{-4} Pa) and deposition rate is approximately 150 angstrom/minute. The size of one element is 3 mm × 3 mm, and 15 elements are manufactured on a substrate of 25 mm × 35 mm.

[0047]

A direct-current voltage is applied to an organic thin film light emitting element which is manufactured as described above so that an anode of the organic thin film light emitting element is positive and a cathode of that is negative. When light emission from a glass substrate side is observed, green light emission of 1 cd/m^2 is started by applied voltage of 3V, and the green light emission is observed for a long time. Therefore, when the applied voltage by which luminance of 1 cd/m^2 is obtained is defined as a light emission starting voltage, the light emission starting voltage of the element of the present embodiment is 3 V. Further, luminance of 20 cd/m^2 is observed when 5 V is applied. The highest luminance is 300 cd/ m^2 by the applied voltage of 12 V.

[0048]

Comparative Example 1.

ITO of 1500 angstrom is formed as an anode on a glass substrate by a radio frequency magnetron sputtering method, and thereover, a hole transporting layer, a light emitting layer and an MgAg electrode are vacuum-deposited by the same method as the embodiment 2 in order to manufacture an element for comparison. In this element for comparison, the applied voltage by which luminance of 1 cd/m^2 is obtained; namely, the light emission starting voltage is 5 V. The capability is obtained that the highest luminance is 5000 cd/m^2 by the applied voltage of 15 V. Luminous efficiency is approximately 0.85 lm/W by drive current of 10 mA/cm^2. When the emission lifetime of this element is measured under a drive condition of 10 mA/cm^2, a half lifetime (a time in which the initial luminance is halved) is 80 hours as shown in FIG. 4.

[0049]

Comparative Example 2.

In_2O_3 of 1500 angstrom is formed on a glass substrate by a radio frequency magnetron sputtering method, and thereover, a hole transporting layer, a light emitting

layer and an MgAg electrode are vacuum-deposited by the same method as the embodiment 2 in order to manufacture an element for comparison. In this element for comparison, the light emission starting voltage by which luminance of 1 cd/m^2 is obtained is 7 V, and the highest luminance is 4000 cd/m^2 by the applied voltage of 15 V.

[0050]

Comparative example 3.

SnO_2 of 1500 angstrom is formed on a glass substrate by a radio frequency magnetron sputtering method, and thereover, a hole transporting layer, a light emitting layer and an MgAg electrode are vacuum-deposited by the same method as the embodiment 2. In this element, the light emission starting voltage by which luminance of 1 cd/m^2 is obtained is 7 V, and the highest luminance is 4000 cd/m^2 by the applied voltage of 15 V.

[0051]

When the embodiment 2 and the comparative examples 1, 2 ,3 are compared, it is understood that the light emission starting voltage is lowered in the element according to the present invention. However, since the light transparency of the vanadium oxide electrode is low, sufficient luminance cannot be achieved. Therefore, an embodiment of a two-layer electrode in which the light transparency is improved by laminating with an ITO thin film is shown as follows.

[0052]

Embodiment 3.

ITO of 1200 angstrom and a vanadium oxide thin film of 300 angstrom are formed continuously over a glass substrate by a radio frequency magnetron sputtering method in order to form a two-layer structure electrode (transparent electrode). Over this electrode, as in the embodiment 2, a hole transporting layer of approximately 500 angstrom, a light emitting layer of approximately 500 angstrom and an MgAg electrode of approximately 1800 angstrom are formed to manufacture an organic thin film light emitting element. A result of measuring the light emission starting voltage and the luminous efficiency of this organic thin film light emitting element is shown in Table 4.

[0053]

[Table 4]

	Transparent Electrode	Light Emission Starting Voltage (V)	Luminous Efficiency (lm/W)
Embodiment 3	VOx/ITO	3	0.92
Embodiment 4	RuOx/ITO	3.5	0.85
Embodiment5	MoOx/ITO	3.5	0.80
Conventional Example	ITO	5	0.85

As shown in Table 4, the light emission starting voltage of this element is 3 V. In addition, as shown in FIG. 5, luminance of 100 cd/m^2 is observed when only 5 V is applied. The highest luminance is 5000 cd/m^2 by 12 V, and the luminous efficiency is 0.92 lm/W (drive current 10 mA/cm^2). When the half lifetime of this element is measured under a drive condition of 10 mA/cm^2, it is over 100 hours as shown in FIG. 4. It is understood that strong light can be emitted by lower applied voltage and the luminous efficiency is improved, besides, the emission lifetime is longer, as compared with an element using only ITO.

[0054]

Further, in the case of a two-layer structure electrode in which the vanadium oxide thin film is set to be 100 angstrom, the light emission starting voltage is 3 V and it is not different from the above described example, however, the highest luminance is increased and the luminous efficiency is 1.0 lm/W.

[0055]

Embodiment 4.

Over a two-layer structure electrode in which ITO of 1400 angstrom and a ruthenium oxide thin film of 300 angstrom are formed over a glass substrate, a hole transporting layer of approximately 500 angstrom, a light emitting layer of approximately 500 angstrom and an MgAg electrode of approximately 1800 angstrom are formed as in the embodiment 2 in order to manufacture an organic thin film light

emitting element, and the light emission starting voltage and the luminous efficiency are measured as in the embodiment 3.

[0056]

The light emission starting voltage of this element is 3.5 V as shown in Table 4. Additionally, luminance of 30 cd/m^2 is observed when 5 V is applied (FIG. 4). The luminous efficiency is 0.85 lm/W.

[0057]

In the present embodiment, if the film thickness of the ruthenium oxide is made further thinner, the light transmittance of the electrode is improved, and thus the efficiency is further improved.

[0058]

Embodiment 5.

Over a two-layer structure electrode in which ITO of 1200 angstrom and molybdenum oxide of 300 angstrom are formed continuously over a glass substrate, a hole transporting layer, a light emitting layer and an electrode are vacuum-deposited as in the embodiment 2 in order to manufacture an organic thin film light emitting element, and the light emission starting voltage and the luminous efficiency are measured as in the embodiment 3.

[0059]

As shown in Table 4, the light emission starting voltage of this element is 3.5 V, and the luminance is 30 cd/m^2 by the applied voltage of 5 V (FIG. 5).

[0060]

Embodiment 6.

Next, an embodiment of an element in which light is taken from an upper electrode (cathode) is shown.

[0061]

FIG. 3 shows a cross-sectional view of an organic thin film light emitting element according to the present embodiment. In FIG. 3, ruthenium oxide of 1500 angstrom is formed as an anode 12 on a glass substrate 10, and thereover, a hole transporting layer 18 and a light emitting layer 16 are vacuum-deposited as in the

embodiment 2. Finally, as a cathode 14, aluminum-doped zinc oxide of approximately 1200 angstrom whose work function is low is formed by a radio frequency sputtering method.

[0062]

When plus voltage is applied to the ruthenium oxide electrode (the anode 12) in this element and light is observed through the zinc oxide electrode (the cathode 14), clear light emission is observed from the transparent cathode 14 side. In this case, light emission with a higher contrast ratio than in the case of the MgAg metal electrode is obtained since the ruthenium oxide electrode is black in color.

[0063]

[Effect of the Invention]

As described above, according to the present invention, the energy barrier between a metal oxide thin film electrode and a hole transporting layer or a light emitting layer can be small so that a hole is easily injected into the hole transporting layer or the light emitting layer and the element can be driven by lower applied voltage. As a result, luminous efficiency is improved and a longer lifetime of the element is achieved. Therefore, the light emitting element of the present invention can be applied to various display fields.

[Brief Description of the Drawings]

[FIG. 1] A cross-sectional view of an organic thin film light emitting element according to the present invention.

[FIG. 2] A cross-sectional view of a two-layer structure electrode according to the present invention.

[FIG. 3] A cross-sectional view of an organic thin film light emitting element in which light is taken from a cathode according to the present invention.

[FIG. 4] A diagram showing luminance change corresponding to a drive time of various elements.

[FIG. 5] A diagram showing the relationship between applied voltage and luminance of various elements.

[FIG. 6] A cross-sectional view of an organic thin film light emitting element having a

single layer structure.

[FIG. 7] A cross-sectional view of a two-layer structure organic thin film light emitting element having a hole transporting layer.

[FIG. 8] A cross-sectional view of a two-layer structure organic thin film light emitting element having an electron transporting layer.

[FIG. 9] A cross-sectional view of a three-layer structure organic thin film light emitting element.

[Explanation of Reference Numerals]

10 Substrate

12 Anode

14 Cathode

16 Light emitting layer

18 Hole transporting layer

20 Electron transporting layer

22 ITO layer

24 Metal oxide thin film